

I CLAIM:

1 A method for monitoring biological micro-structure activity which  
2 produces detectable signals characterizing events, comprising the steps of estimating the  
3 fundamental frequency of the occurrence of events from the detectable signals, without  
4 detecting the occurrence of individual events.

1 2. The method of claim 1 wherein events are analyzed during an analysis  
2 window which spans more than one event.

1 a 3. The method of any of claims 1 or 2 wherein the events are signals  
2 produced by biological micro-structures which are displaced from their original environment.

1 a 4. The method of any of claims 1 or 2 wherein the events are signals  
2 produced by living cells.

1 5. The method of claim 4 wherein the events are signals produced by the  
2 Islets of Langerhans.

1 b 6. The method of any one of claims 1 or 2 wherein the estimating step  
2 includes an autocorrelation operation.

1 7. The method of claim 6 further including one of the following steps:  
2 estimating the fundamental frequency based upon a lower  
3 autocorrelation value disposed among several adjacent peaks;  
4 treating "unvoiced" segments of the detectable signal as undecided as  
5 to pitch and estimating the pitch of those segments through subsequent processing;  
6 seeking to estimate the fundamental frequency in the range of .25 to 5  
7 Hertz;  
8 utilizing an analysis window duration in the range of several seconds;  
9 performing a pre-processing operation which has the effect of  
10 increasing the effective duration of an event; and  
11 utilizing an autocorrelation process which performs segmented

12 autocorrelation.

1 8. The method of Claim 1 further comprising the step of using the number  
2 of "unvoiced" windows within a predetermined time as a measure of a blood constituent level  
3 of a patient.

1 9. The method of Claim 1 further comprising the step of using a sureness  
2 grade as measure of a blood or tissue constituent level of a patient.

1 10. The method of Claim 1 further comprising the step of using the  
2 fundamental frequency as a measure of a blood or tissue constituent level of a patient.

1 11. The method of Claim 1 wherein the blood constituent level is the blood  
2 glucose level in the vicinity of the biological micro-structure.

1 12. The method of claim 1 wherein the events are electrical signals  
2 produced by living cells in the Islets of Langerhans used as a probe within a patient and the  
3 fundamental frequency estimate is used as a measure of blood glucose level of the patient.

1  $\alpha$  13. The method of <sup>claim 1</sup> ~~any one of claims 2~~, wherein an analysis window spans  
2 a duration of up to 40 times the interval between successive events..

1 14. In a system for monitoring biological micro-structure activity which  
2 produces detectable signals characterizing events, a sensor capable of receiving the sensible  
3 signals and a processor including a module for estimating the fundamental frequency of the  
4 occurrence of events from the detectable signals, without first detecting the occurrence of  
5 individual events.

6 15. The system of claim 14 wherein the processor further comprises a  
7 module for producing an analysis window during which events are analyzed, the analysis  
8 window spanning more than one event.

1  $\alpha$  16. The system of Claim ~~14~~ or 15 wherein the module for estimating

1 includes components to perform an autocorrelation operation.

1 17. The system of Claim 16 wherein the module for estimating further  
2 includes one of the following submodules:

3 a submodule which estimates the fundamental frequency based upon  
4 a lower autocorrelation value disposed among several adjacent peaks;

5 a sub-module which identifies "unvoiced" segments of the detectable  
6 signal as undecided as to pitch, the pitch of those segments being estimated by a subsequent  
7 processing submodule;

8 a submodule which controls the estimate of the fundamental frequency  
9 to be in the range of .25 to 5 Hertz;

10 a submodule controlling the analysis window to have a duration in the  
11 range of several seconds; and

12 a submodule performing a pre-processing operation which has the effect  
13 of increasing the effective duration of an event.

1 a 18. The system of Claim ~~14~~ or 15 wherein the processor is constructed to  
2 perform a segmented autocorrelation process.

1 a 19. The system of claim ~~14~~ or 15 wherein the sensor is a probe capable of  
2 detecting signals emitted by living cells in the Islets of Langerhans, the frequency estimate  
3 being an indication of blood glucose level of a patient in which those cells are present.

1 a 20. The system of <sup>claim 15</sup> ~~any one of claims 14 or 15~~, wherein an analysis window spans  
2 a duration of up to 40 times the interval between successive events..

add a1  
add B1